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Research Article

Comparison of ultrasound-guided fascia iliaca compartment block versus the combined obturator nerve and adductor canal block application in postoperative analgesia for patients undergoing arthroscopic knee surgery

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ABSTRACT

Background: Arthroscopic knee surgery is a surgical intervention that is frequently performed by orthopedic clinics and new studies are constantly carried out by anesthetists to ensure effective pain control. This study aimed to compare the efficacy of ultrasound-guided suprainguinal fascia iliaca compartment block (FICB) versus the combined adductor canal and obturator nerve block application in terms of postoperative analgesia in patients undergoing arthroscopic knee surgery under spinal anesthesia.

Materials and Method: Sixty patients, who underwent arthroscopic knee surgery under elective conditions were included in the study. They were randomly divided into two groups, Group 1 (n=30) and Group 2 (n=30), using a lottery method. Patients operated under spinal anesthesia received ultrasound-guided suprainguinal fascia iliaca compartment block (FICB) for Group 1. The combined adductor canal and obturator nerve block for Group 2 at the end of the surgery. Intravenous patient-controlled analgesia (PCA) device containing tramadol was connected to all patients in both groups, and they were evaluated for Visual Analog Scale (VAS) scores at 0, 2, 4, 12, and 24 hours of ward follow-up. The amount of PCA used at 24 hours, additional analgesic use, development of side effects, mobilization capabilities, and satisfaction levels were assessed at the end of 24 hours.

Results: There were no significant differences between the groups in terms of demographic characteristics and the type of surgery performed ($p>0.05$). In Group 1, where fascia iliaca block was applied the block administration time was observed to be significantly shorter compared to Group 2 ($p<0.05$). No significant differences were observed between the two groups in terms of postoperative VAS scores, PCA usage amounts, incidence of side effects, postoperative mobilization abilities, and satisfaction measures ($p>0.05$).

Conclusions: Ultrasound-guided fascia iliaca compartment block alone can be effectively applied for postoperative analgesia in patients undergoing arthroscopic knee surgery, instead of combined adductor canal and obturator nerve block.

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1. Introduction

Knee arthroscopy is a surgical procedure frequently performed by orthopedic clinics [1]. Therefore, there has been increased interest in recent years in neuroaxial interventions, which allow for effective anesthesia while not restricting mobilization and have a narrow side effect profile, to accommodate this rapid turnover in anesthesia management [2].

Femoral nerve block (FNB) has long been used to treat postoperative pain in knee surgery. However, the need for new techniques has arisen due to its limitation on hip mobilization. Adductor canal block is one of these developed blocks, aiming to reduce this adverse effect by blocking the femoral nerve more distally. Barely, its analgesic effect being limited to only the anterior aspect of the knee has narrowed its utility. Combining it with obturator nerve block aims to broaden the area of effect. However, the simultaneous application of both blocks may not always be feasible in terms of technical proficiency and may prolong the procedure compared to a single-block application, restricting its usage [3–5].

In this study aimed to compare the effects of combined adductor canal block and obturator nerve block with the single application of ultrasound-guided suprainguinal fascia iliaca compartment block (FICB) on postoperative pain. According to this study, both block groups can be applied instead of each other, but FICB will be more preferred because ıt can be applied easily.

2. Materials and Method

This study was conducted prospectively and randomized between June 1, 2019, and September 30, 2020, with the approval of the Clinical Research and Ethics Committee of Kahramanmaraş Sütçü İmam University Health Practice and Research Hospital in its session dated May 29, 2019, numbered 2019/10, and decision number 20. A total of 60 patients who underwent arthroscopic knee surgery at the orthopedic clinic, after obtaining informed consent, were included in the study. Patients aged between 18 and 65 years with ASA I-II who underwent surgery under spinal anesthesia were examined.

Patients were informed in detail about the study during the preoperative period, and after obtaining voluntary consent using a consent form, they were randomized by the lottery method into two groups: those who underwent fascia iliaca compartment block were assigned to Group 1, and those who underwent adductor canal and obturator nerve block were assigned to Group 2. Blocks were performed after the completion of surgery for patients under spinal anesthesia and block applications in both groups were performed by the same person.

Group 1: Following the completion of the surgery, patients in Group 1 received a suprainguinal fascia iliaca block using the technique. For this application, the patient was placed in a supine position, and after ensuring the necessary skin asepsis conditions, a linear ultrasound probe was placed on the distal and medial 1/3 of the imaginary line connecting the superior iliac crest and the pubic tubercle, 1 cm above the inguinal ligament, in the transverse plane. In the imaging, femoral artery, femoral vein, iliac and sartorius muscles, and fascia lata and iliaca were visualized in a hyperechoic manner. The needle was directed from lateral to medial in an in-plane technique, penetrating the fascia iliaca after the fascia lata and the junction of the iliac and sartorius muscles. After negative aspiration, a total of 40 ml of 0.25% concentration bupivacaine was injected slowly and intermittently with controlled aspiration. Spread of the local anesthetic laterally and medially was observed.

Group 2: In this group, adductor canal block followed by obturator block was applied. After the surgery, the patient was placed in a supine position, and the leg to be treated was slightly externally rotated for the adductor canal block procedure. After ensuring skin asepsis, a linear ultrasound probe was placed on the inguinal crease of the patient's thigh and approximately at the midpoint of the medial condyle of the knee. Underneath the sartorius muscle, the femoral artery within the adductor canal, the femoral vein beneath the femoral artery, and the saphenous nerve laterally were visualized. Using an in-plane technique, a 100mm 22G block needle was inserted 1–2 cm lateral to the ultrasound probe. The needle was advanced under the sartorius muscle and laterally to the femoral artery and saphenous nerve, and then 10 ml of 0.25% concentration bupivacaine was injected after negative aspiration.

To perform obturator nerve block, after ensuring aseptic conditions of the skin surface in the inguinal region while the patient was in the supine position, the same ultrasound probe was used for the procedure. Underneath the fascia lata in the inguinal region, the femoral artery and vein were visualized. The probe was shifted medially to visualize the 'Y' shaped boundary formed by the pectineus muscle, and the adductor longus and brevis muscles immediately medial to it. For blocking the anterior branch of the obturator nerve, the needle was advanced in-plane towards the hyperechoic linear structure in the fascial gap at the junction of the middle and posterior thirds of the pectineus and adductor brevis muscles. After negative aspiration in this area, 5ml of 0.25% bupivacaine was injected. Similarly, the needle was advanced in-plane towards the posterior branch of the obturator nerve between the adductor brevis and adductor magnus muscles, and after negative aspiration in this area, 5ml of 0.25% bupivacaine was injected. Proper spread of the local anesthetic agent was observed, with the agent spreading in the fascial gap and separating the target muscle groups from each other.

After achieving full cooperation from the patients following the procedure, intravenous patient-controlled analgesia (PCA) was administered, and its usage was thoroughly explained before they were sent to the ward. Pain assessment using the Visual Analog Scale (VAS) was conducted and recorded at postoperative 1, 2, 4, 12, and 24 hours in the ward. Patients with a VAS score of 4 or higher, despite using PCA analgesia, were administered intravenous analgesics. The amount of analgesic used at the end of 24 hours, additional analgesic requests, development of side effects, the type of side effects, were evaluated and recorded. Satisfaction levels were assessed using a four-point Likert scale (very satisfied, satisfied, neutral, and dissatisfied).

Mobility abilities of patients were assessed at the 24-hour ward visit. This assessment included evaluating their ability to sit up, stand, walk, and extend, and it was compared between groups.

Patients who received general anesthesia, those with allergies to local anesthetics and/or drugs used in the study, those who did not use the PCA device for any reason within the first 24 hours postoperatively, those who were not willing to participate in the study, and patients with a history of peripheral neuropathy or neuromuscular disease were not included in the study

3. Sample Size and Statistical Analyses

Sample size was calculated using G Power3 analysis program (Heinrich-Heine University, Dusseldorf, Germany) before the study. A pilot study was conducted on 5 patients from each group. The power analysis was conducted based on the average postoperative analgesic consumption with PCA. The sample size was calculated with a power of 95% and a significance level of 5%. It was determined that approximately 27 patients per group were needed to obtain a statistically significant value. Considering possible data deficiencies and patient dropouts for any reason, 30 patients were included in each group.

For the statistical analysis of the data obtained in the study, SPSS (Statistical Package for Social Sciences) for Windows 22.0 program was used. Chi-square analysis was used for comparing categorical data. Data were presented as mean ± standard deviation, median (Min-Max), number, and percentage. The normal distribution of numerical data was tested using the Kolmogorov-Smirnov test. Independent samples t-test was used for comparing normally distributed paired numerical data, one-way ANOVA test was used for comparing more than two groups, and Mann-Whitney U test was used for comparing non-normally distributed paired numerical data. Kruskal-Wallis test was used for comparing more than two groups of non-normally distributed data. Significance was considered at $p<0.05$ level.

4. Results

A total of 60 patients were included in the study, with 30 patients receiving Fascia Iliaca compartment block (Group 1) and 30 patients receiving Adductor Canal + Obturator nerve block (Group 2). Table 1 presents the characteristics of the participants in terms of gender, age, weight, height, body mass index, and ASA scores within the study groups. According to the data, there was no statistically significant difference observed between the study groups in terms of sociodemographic characteristics (Table 1).

Table 1. Comparison of sociodemographic characteristics of the groups.

		Group 1		Group 2		p
		Number	%	Number	%	
Gender, n(%)	Female	4	13.3	3	10	0.688[a]
	Male	26	86.7	27	90	
ASA	ASA-1	18	60.0	24	80.0	0.091[a]
	ASA-2	12	40.0	6	20.0	
Age (Years), Mean±SD		33.7±13.8		31.1±10.3		0.401[b]
Weight (kg), Mean±SD		81.6±12.0		77.3±12.0		0.173[b]
Height (cm), Mean±SD		173.0±8.8		172.9±6.0		0.945[b]
BMI (kg/m2), Mean±SD		27.4±4.4		25.8±3.7		0.134[b]

[a]Chi-square; [b]t-test was applied in independent groups

In terms of evaluating the type of surgery for both groups (p=0.898), the lateralization of the surgery (p=0.436), and the duration of the surgery (p=0.646), no statistically significant difference was observed.

When groups were compared in terms of procedure durations according to the type of block performed, in Group 1, the minimum duration of the procedure was 5 minutes, the maximum was 10 minutes, and the median was 10 minutes, whereas in Group 2, the minimum duration of the procedure was 7 minutes, the maximum was 15 minutes, and the median was 12 minutes. The application duration of the adductor canal block and obturator nerve block was found to be significantly higher compared to the application duration of the fascia iliaca compartment block alone ($p<0.001$) (Table 2).

Table 2. Comparison of the block application durations between the groups.

	Group 1			Group 2			p[a]
	Median	Min	Max	Median	Min	Max	
Block application duration (min)	10	5	10	12	7	15	<0.001

[a]Mann Whitney U test was applied

When compared in terms of the type of block performed and postoperative pain levels, the mean VAS scores at 1st, 2nd, 4th, 12th, and 24th hours for Group 1 were 1.3±1.5, 1.6±1.8, 2.6±1.8, 4.1±2.3, and 1.9±1.1, respectively, while the mean VAS scores for Group 2 were 1.5±1.6, 1.7±1.5, 2.9±1.5, 4.9±2.4, and 2.6±1.8, respectively. No significant difference was observed in the evaluation of postoperative pain for both groups in terms of VAS scores at different time points (Table 3).

Similar results were obtained in terms of the number of requests to use patient-controlled analgesia device and the number of boluses administered through the patient-controlled analgesia device in both groups (Table 4). When patients are compared in terms of additional analgesic need; It was observed that additional medication was administered to 14 patients in group 1 and 16 patients in group 2, and no statistically significant difference was observed (p=0.606).

No significant difference was observed in terms of chair test, walking distance, and extension duration conducted to evaluate the effectiveness of applied blocks on postoperative mobilization (Table 5).

Table 3. Comparison of VAS scores at different time points between groups.

	Group 1	Group 2	p[a]
	Mean±SD	Mean±SD	
VAS 1st hour	1.3±1.5	1.5±1.6	0.735
VAS 2nd hour	1.6±1.8	1.7±1.5	0.698
VAS 4th hour	2.6±1.8	2.9±1.5	0.532
VAS 12th hour	4.1±2.3	4.9±2.4	0.214
VAS 24th hour	1.9±1.1	2.6±1.8	0.074

[a]Mann Whitney U; [b] t test was applied in independent groups

Table 4. Comparison of PCA request and PCA bolus numbers between groups.

	Group 1			Group 2			p
	Median	Min	Max	Median	Min	Max	
PCA request count	12.5	0	69	15	1	42	0.728[a]
PCA bolus count, Mean±SD		8.6±4.9			9.5±6.8		0.573[b]

[a]Mann Whitney U; [b] t test was applied in independent groups

Table 5. Comparison of groups in terms of chair test, walking distance, and extension duration.

	Group 1			Group 2			p[a]
	Median	Min	Max	Median	Min	Max	
Chair test count	3	0	7	2	0	6	0.928
Walking distance (m)	37.5	0	90	32.5	0	90	0.458
Extension time (s)	11.5	2	60	14	0	55	0.711

[a]Mann Whitney U test was applied. Chair test: The number of sit-to-stand repetitions within 30 seconds; Walking distance: The distance walked within 3 minutes provided in meters

5. Discussion

The success of anesthesia applications in outpatient surgical procedures depends on early ambulation, minimizing pain, and minimal postoperative side effects, especially in lower extremity surgery [6–8]. In this study was evaluated the postoperative analgesic efficacy, effects on postoperative mobilization, effects on length of hospital stay, side effects, and effects on additional analgesic use of fascia iliaca compartment block (FICB) compared to adductor canal block and obturator nerve block, which are commonly performed in knee arthroscopy surgery. In the literature review, no studies were found comparing the combination of suprainguinal fascia iliaca compartment block with adductor canal block and obturator nerve block in patients undergoing knee arthroscopy surgery, as in this study. The most similar research to this study was conducted by Abu Elyazed et al. [9]. However, in this study, the obturator nerve block was added to the adductor canal block to standardize the nerve block. Abu Elyazed et al. [9] found no significant difference in VAS evaluations performed within the first 24 hours in patients undergoing knee arthroscopy surgery who received fascia iliaca compartment block and adductor canal block.

In this study, it was found that both groups were similar in VAS evaluations at postoperative 1, 2, 4, 12, and 24 hours, and there was no statistically significant difference. Likewise, there was no significant difference in the amount of tramadol and additional analgesic used. In a study by Abu Elyazed et al. [9], it was stated that the adductor canal block was better in the assessment of quadriceps strength at 6, 12, and 18 hours, and there was no significant difference at the 24-hour assessment [9]. In this study, both groups were evaluated for mobilization capability at postoperative 24 hours, and no significant statistical difference was found between the two groups.

According to a meta-analysis comparing femoral block and fascia iliaca block applied to patients undergoing hip and knee arthroplasty by Wang et al. [10], there

was no significant difference between the two groups in terms of VAS scores at 12 hours and the amount of analgesics used in PCA. Similarly, it was reported that VAS scores at 24 and 48 hours and analgesic use were similar. In a study where the same blocks were performed on adolescent patients undergoing knee surgery, no significant difference was found between the groups in terms of VAS values between hours and the amount of opioids used postoperatively [11].

A meta-analysis comparing adductor canal block with femoral nerve block in patients undergoing total knee arthroplasty found that postoperative VAS scores were between low and moderate, and there was no significant difference in activity and rest between them [12]. In the meta-analysis of Jenstrup et al. [4], it was stated that the level of pain and analgesic consumption with femoral nerve block and adductor canal block were similar. Additionally, it was mentioned that patients receiving adductor canal block had less negative effects on mobilization, thus minimizing complications that could arise due to prolonged immobilization and reducing length of hospital stay [3,13].

There are studies indicating that obturator nerve block alone does not provide sufficient postoperative analgesia. However, it is theoretically known that it is responsible for innervation of the medial part of the knee and that adequate analgesia cannot be achieved if it is not blocked. Therefore, various studies have shown that it is applied in addition to other peripheral nerve blocks such as femoral nerve block and femoral+sciatic nerve block and adductor canal block to increase the effectiveness of postoperative analgesia [13–15].

One of the common complications of peripheral nerve blocks is neurovascular trauma. There is a risk in all three block types we applied. In a study by McNamee et al. [14], no neural trauma or deficit was found in the fascia iliaca group, but deficit developed in one out of 47 patients in the femoral block group. In a study, myotoxicity developed in 3 patients due to adductor canal block application [16]. With the widespread use of ultrasound in regional anesthesia applications and the widespread dissemination of education on this subject, the risk of complication development has significantly decreased. In this study, no complications such as neurotoxicity, myotoxicity, or vascular injection were observed in the applied blocks.

In the literature review, no evaluation was found regarding the ease of application of fascia iliaca compartment block compared to other blocks in this study. However, the application time of fascia iliaca compartment block was found to be significantly shorter than the combined application time of adductor canal block and obturator nerve block.

When evaluated in terms of early discharge, one of the most important parameters of outpatient surgery, both groups' patients were generally discharged within twenty-four hours, and no significant difference was observed. According to a meta-analysis comparing femoral block with fascia iliaca compartment block, it was stated that both groups were similar in terms of length of hospital stay [9]. In conclusion, evaluating dermatomes and early mobilization ability along with VAS assessment in this study could have made our study stronger; however, it could have been misleading as the orthopedic clinic required patients to be immobilized for the first 24 hours and the operations were performed under spinal anesthesia. Thirty patients who received a fascia iliaca block technique and thirty patients who received obturator nerve and adductor canal blocks were included in the study. When the sociodemographic characteristics of the participants were compared, they were found to be similar. This ensured the elimination of some bias sources that could lead to bias in the study results, and it was considered that the type of block applied could directly contribute to the differences or similarities observed in the study results.

6. Conclusions

The fascia iliaca compartment block, which has proven analgesic efficacy like other long-established and effective blocks used in the lower extremity, can easily replace other block applications due to its short application time, ease of administration, and low risk of complications.

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Conflict of Interest

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Author Contributions

All of the authors made substantial contributions to conception and design, or acquisition of data, or analysis and interpretation of data; were involved in drafting the manuscript or revising it critically for important intellectual content; and gave final approval of the version to be published.

Data Availability

The datasets created and/or analyzed during the current study are not publicly available, but are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the ethics committee of Kahramanmaraş Sütçü İmam University Faculty of Medicine (May 29, 2019; numbered 2019/10; and decision number 20). Written informed consent was obtained from the participants. All methods were performed in accordance with relevant guidelines and regulations.

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